WHAT IS CLAIMED IS:

1. A method of growing a silicon carbide single crystal on a silicon carbide seed crystal in an inert gas atmosphere in a vessel, comprising the steps of:

establishing the seed crystal temperature to a growth temperature T_{seed} and establishing the temperature of source material to a growth temperature T_{source} that is higher than T_{seed} to define a thermal gradient therebetween;

maintaining constant seed temperature and constant source temperature throughout substantially the entire growth period of the single crystal, said entire growth period beginning when the seed crystal and source material reach T_{seed} and T_{source}, respectively; and

changing only the pressure of the inert gas during the entire growth period to control the growth rate of the single crystal.

2. The method according to claim 1, wherein said entire growth period includes a preliminary period for growing a base of the single crystal and a main period for growing a remaining portion of the single crystal, and wherein said step of changing the pressure includes:

(a) establishing the pressure at a first pressure P_1 and holding the pressure at P_1 for a duration which is adequate to heal defects on the seed-crystal interface and to grow a base for the simple crystal on the seed for said preliminary period; and

(b) after growing said base, further reducing the pressure from $P_ø$ to a second pressure P_2 to continue growing the single crystal during said main period.

3. The method according to claim 2, wherein P_1 is selected from the range of approximately 10 to approximately 50 Torr, and P_2 is preselected to be less than about 10 Torr.

4. The method according to claim 2, wherein the pressure is held at P_2 for said remaining period of the entire growth period, until the pressure is raised to stop the growth.

5. The method according to claim 2, wherein said preliminary period of said entire growth period is at least 0.5 hours.

6. The method according to claim 1, further comprising the steps of:

first raising the gas pressure to a pressure $P_ø$ that blocks transport of the source to the seed before the temperatures T_{seed} and T_{source} are obtained; and

providing a period of stabilization where pressure at $P_{ø}$ as well as temperatures T_{seed} and T_{source} are maintained before decreasing the pressure to begin growth of the crystal.

7. The method according to claim 1, further comprising the steps of:

at the end of the growth period, raising the pressure to stop the growth of the single crystal; and

lowering the temperatures of the seed crystal and source material down to room temperature.

8. The method according to claim 1, further comprising a preliminary degassing step including the steps of:

before the growth period:

raising the temperature inside the vessel above room temperature but below 1600°C; and

lowering the pressure to a predetermined pressure P_{degas} to remove contaminating particles from the vessel.

9. The method according to claim 8, wherein said P_{degas} is equal to or less than 0.2 Torr.

10. A method of growing a silicon carbide single crystal in an inert gas environment in a vessel, comprising the steps of:

during an entire growth period, maintaining substantially constant seed crystal and substantially constant source material temperatures and only adjusting the pressure of said inert gas to change the growth rate of the single crystal, said growth period being defined as the period during which any transport of source material to seed crystal occurs.

11. The method according to claim 10, wherein said pressure is first lowered to a first pressure to grow a base of the single crystal and then lowered to a second pressure to grow a remaining portion of the single crystal.

12. A method of growing a silicon carbide single crystal in an inert gas environment in a vessel, comprising the steps of:

raising temperature of a SiC source material in a first zone in the vessel to a temperature sublimation of said SiC source material can occur thereby forming a vapor

species, and maintaining temperature of an SiC seed crystal in a second zone in the vessel at a temperature where condensation of said vapor species can occur;

during an entire growth period, maintaining said seed crystal and said source material temperatures constant and only adjusting the pressure of said inert gas to change the growth rate of the single crystal; and

lowering said seed crystal and said source material temperatures directly back down to room temperature after said entire growth period.

13. The method according to claim 12, wherein said entire growth period includes:

a preliminary period where pressure is first lowered to grow a base of the single crystal, and

a main period where pressure is lowered further after said preliminary period to grow a remaining portion of the single crystal.

14. The method according to claim 12, wherein said temperatures of the seed and source material are temperatures that avoid super saturation and are sufficient to prevent the formation of macrodefects that significantly adversely affect a crystal lattice of the single crystal.

15. A method of growing a silicon carbide single crystal in an inert gas environment in a vessel, comprising the steps of:

raising temperature inside a first zone of the vessel with a source material that enables sublimation of said source material into a vapor species, and maintaining temperature of a second zone of the vessel with a seed crystal that enables condensation of said vapor species;

maintaining said source material and said seed crystal temperatures constant throughout an entire growth period of the single crystal; and

changing the growth rate of the single crystal during the growth period only by adjusting the pressure of the inert gas,

said entire growth period being defined from when pressure is first reduced to permit transport of source material to said seed crystal and to the time when said pressure is increased to end growth of the single crystal.

16. The method according to claim 15, wherein said temperatures of the seed and source material are temperatures that avoid super saturation and are sufficient to prevent the formation of macrodefects that significantly adversely affect a crystal lattice of the single crystal.

17. A method of growing high quality silicon carbide single crystals by physical vapor transport in an inert gas environment in a vessel, comprising the steps of:

(a) preheating including the substeps of:

(i) raising the pressure of the inert gas to a non-transport pressure that prevents mass transport of source material to the seed crystal,

(ii) heating a SiC source material to a sublimation temperature, and

(iii) maintaining an SiC seed crystal at a condensation temperature;

(b) stabilizing including the step of holding said seed crystal and said source material temperatures and said non-transport pressure for a duration sufficient to establish thermal equilibrium in the vessel;

(c) preliminary growth including the steps of:

lowering pressure of said inert gas to a first pressure without changing any temperature, and

holding said first pressure including the steps of

preventing macrodefect formation on a seed crystal surface, and

growing a base of the single crystal on the seed crystal at a first growth rate;

(d) main growth including the step of further lowering the pressure of the inert gas to a second pressure for continuing the growth of the single crystal at a second growth rate that is faster than said first growth rate;

(e) growth termination including the step of increasing the pressure to stop transport of source material to said seed crystal;

(f) cooling including the step of decreasing the temperature inside the vessel from said source material and said seed crystal temperatures; and

(g) opening said vessel including the step of changing the pressure to equalize the pressure relative to pressure external to the vessel.

18. The method according to claim 17, wherein said step (c) lasts for at least 0.5 hours.

19. The method according to claim 17, further comprising a degassing step before step (a) where temperature inside the vessel is raised above room temperature but below said seed crystal temperature, and pressure is decreased to a level sufficient to remove air and contaminants from said vessel.

20. The method according to claim 17, wherein said step (d) further includes the step of introducing doping gases.

21. The method of claim 17, wherein said step (c) is maintained for approximately three hours and said step (d) is maintained for at least approximately 3 hours.

22. An apparatus for growing silicon carbide single crystals, comprising:

a vessel holding a SiC seed crystal in one zone and SiC source material within another zone in the vessel;

a means for controlling the temperature within the vessel so that said seed crystal is maintained at a constant temperature T_{seed} and said source material is maintained at a constant temperature T_{source} where $T_{source} > T_{seed}$, said temperatures being held constant throughout an entire growth period of the single crystal; and

means for controlling the pressure of inert gas within the vessel to adjust the pressure to control a growth rate of the single crystal.

23. The apparatus according to claim 22, wherein said entire growth period includes a preliminary period for growing a base of the single crystal and a main period for growing a remaining portion of the single crystal, and

wherein said means for controlling pressure:

(a) establishes the pressure at a first pressure to P_1 and holds the pressure at P_1 for a duration which is adequate to heal defects on the seed-crystal interface and to grow a base for the simple crystal on the seed for said preliminary period; and

(b) after growing said base, further reduces the pressure from $P_ø$ to a second pressure P_2 to continue growing the single crystal during the main period.

24. The apparatus of claim 23, wherein P_1 is selected from the range of approximately 10 to approximately 50 Torr, and P_2 is preselected to be less than about 10 Torr.

25. The apparatus according to claim 23, wherein said means for controlling the pressure holds the pressure at P_2 for said remaining period of the entire growth period, until it raises the pressure to stop the growth.

26. The apparatus according to claim 23, wherein said preliminary period step of growing said base lasts at least 0.5 hours.

27. The apparatus according to claim 22, wherein said means for controlling the pressure first raises the gas pressure to a pressure $P_ø$ that blocks transport of the source to the seed before the temperatures T_{seed} and T_{source} are obtained, and provides a period of stabilization by holding pressure at $P_ø$ while said means for controlling the temperature maintains T_{seed} and T_{source} before the means for controlling the pressure decreases the pressure to begin growth of the crystal.

28. The apparatus according to claim 22, wherein said means for controlling the pressure and said means for controlling the temperature, at the end of the growth period, respectively raises the pressure to stop the growth of the single crystal and lower the temperatures of the seed crystal and source material down to room temperature.

29. The apparatus according to claim 22, wherein, before the growth period,

said means for controlling the temperature raises the temperature inside the vessel above room temperature but below T_{seed}; and

said means for controlling the pressure lowers the pressure to a predetermined pressure P_{degas} to remove air and contaminating particles from the vessel.

30. A method of growing a silicon carbide single crystal on a silicon carbide seed crystal in an inert gas atmosphere in a vessel, comprising the steps of:

establishing the seed crystal temperature to a growth temperature T_{seed} and establishing the temperature of source material to a growth temperature T_{source} that is higher than T_{seed} to define a thermal gradient therebetween;

maintaining constant seed temperature and constant source temperature throughout substantially the entire growth period of the single crystal, said entire growth period beginning when the seed crystal and source material reach T_{seed} and T_{source}, respectively; and

changing the pressure of the inert gas without changing said temperatures and without moving either said seed crystal or said source material or both by mechanical means to change a thermal gradient between T_{seed} and T_{source} during the entire growth period to control the growth rate of the single crystal.